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ANNIVERSARY ADDRESS, IOWA ACADEMY OF SCIENCE[1]

THERE is an old and familiar phrase which reads: "To all to whom these presents may come, greeting." I remember how in youthful days this phrase struck me as of peculiar mold and how, without perhaps realizing its antiquity or history, I puzzled as to its full significance and the conditions which, in some distant era, must have given it birth. We need not now attempt to trace its lineage or discover how ancient ambassadors or messengers may have used it in their visits to friend or foe, but I like to fancy for the moment that I am commissioned to bring to you on this anniversary occasion the greetings and congratulations of the world of science. Certain I am that such greetings and congratulations must extend from organized science in general and especially from all societies of similar scope.

Science is essentially mutualistic and the success of one organization is the gratification of all—the triumphs and discoveries of one are shared with the many and the feeling of pride in the progress of the one may be shared without loss by sister organizations. As the discovery made in one branch of science may be the necessary foundation for the solution of some problem in another, so the contribution from one society may be the stepping stone to advancement in another. It is all hail then, greetings and felicitation and Godspeed in the accomplishments of your future destiny.

The state academies of science, or socie-

[1] Delivered at the twenty-fifth anniversary meeting in Des Moines, Iowa, April 26, 1912.

ties of the scope of ours, are of comparatively recent origin, so that the achievements of the quarter century of activity and growth are well worthy of recognition. Such societies have their antecedents in the local academies formed by groups of scientific workers in various cities or limited communities, which again may doubtless be considered as an introduction from the old world, where academies of science under various names have been in active operation for a much longer period of time. Among the first and most notable which were organized in this country are the American Philosophical Society and the Academy of Natural Sciences of Philadelphia, the Brooklyn Academy of Arts and Sciences, the American Academy and the Boston Society of Natural History of Boston, and the St. Louis Academy of Science.

Such local societies were established for the association of scientific workers in centers containing a sufficient number to serve as a stimulus for such work and for a time at which ready communication between distant cities was not so convenient as at the present time. The organization of the state academies, however, seems to have occurred particularly in the central-western country and may be looked upon as resulting from the condition of scientific workers within the boundaries of these commonwealths. The scope of these academies has, however, taken on a somewhat different range, at least for many of them, since they have in many cases served as scientific advisers to the states in which they exist. This particular function of course makes the state boundary of special significance and is perhaps in itself a sufficient basis for the organization of such societies in every state. That very much can be accomplished by such a connection may be seen from the many different scientific activities which have been encouraged or stimulated by the societies or by the individual members under the incentive of associated work. For instance, the geological surveys, biological surveys, topographical surveys, and other enterprises dependent upon state support have in many cases had their origin and in many other cases received their support and encouragement from the state academies.

State academies exist in Wisconsin, Kansas, Iowa, Indiana, Minnesota, Nebraska, California, Ohio, Illinois, Michigan, Colorado, Utah, Oklahoma, Maryland and Tennessee. In some degree they measure the scientific activity of the states, naturally they should flourish in states of large area and less population where the isolation of scientific workers has been a special incentive to their organization. One of the first of these to be organized was the California Academy of Science, followed by the Maryland Academy and the Wisconsin Academy of Arts and Sciences, which latter seems to have been organized with distinct state faculties and state support from the start and with a remarkably full and valuable series of publications to its credit. While its scope is somewhat broader than some of the others so as to include historic and literary productions, so large a part of its work has centered on scientific problems of the state that it is to be counted one of the most fruitful of the state academies devoted to science.

The Kansas Academy of Science, organized in 1867, has been a very active society through all its career, and its reports published by the state constitute a most creditable contribution to the scientific papers of the state.

The Indiana Academy, organized 1885, and which celebrated its quarter-centennial with a notable meeting two years ago, has shown great activity, especially with reference to the problems of the state.

The Ohio Academy, with which I have been associated for a number of years, has enthusiastic annual meetings, publishes its own proceedings, has a research fund contributed by a friend, and has been instrumental in founding several projects of state-wide interest and importance. While its work has been mainly in biology and geology, its programs include papers on widely varied lines of study, and it has been of great service in promoting acquaintance and cordial feeling among the scientific workers of the state.

These few references to particular societies are given not because they are more important than others that might be named, but because they will serve to indicate the scope and sphere of the state organizations in science. They certainly amply justify the effort of the devoted members who have given so unstintedly of time and thought in the upbuilding of the societies and the enterprise they represent.

While the political boundaries of a state do not always best limit the activities of such a society, there is distinct reason for such sphere in the relation the academy may have to state problems of a scientific character. Such a society composed of representative students from various professions and positions may well constitute a useful advisory body for the legislative bodies in dealing with the problems requiring scientific attention, but in addition to this, the many problems that relate themselves naturally within state boundaries or can best be associated with public state enterprises, surveys, etc., give it a rational sphere. Perhaps the most emphatic basis, certainly one of the most forceful to the membership, is the opportunity for acquaintance, good fellowship and friendship among the workers in a common field. This alone would be ample reason for the time and effort given to the periodical meetings.

While these societies do not boast of monumental edifices, great pageantry or display, their place in the world of science is determined by the record of contribution to the world's knowledge and this recognition in their several spheres will be based on their service to the welfare of the communities in which they labor. That this service is a growing one and that its fruition in years to come will bring credit to all those who have labored in their promotion is, I believe, beyond doubt.

They are centers of research and research is the breath of life for science. New investigation and discovery are the essential to activity. This has been shown in every period of the world's history. Witness the stagnation of the middle ages, properly called the dark ages, when authority took the place of progressive research and the conquest of the unknown. As such centers of research the academies are factors in the advancement of learning, and so of the progress of the race. Every one is a force for betterment and speed the day when such forces are operative in every state of the nation.

Sometimes we may think there is an overproduction of scientific societies—especially when dues become payable—but while there may be some with no necessary mission, we can learn to discriminate and encourage those of merit. There is also, I think, less danger of degeneration in a number of fairly independent societies than in a too great centralization with the domination of small circles who happen to be in control.

This Iowa Academy was preceded by an earlier society, organized in 1875, and which held meetings up to 1884, when from the removal of some of its most active members and unfortunate disagreement be-

tween some of those remaining it ceased to exist. I recall, however, with much pleasure the meetings that I attended during the years 1876 to 1884, and the opportunity it afforded to become acquainted with the active scientific workers of the state. Professors Calvin, McBride and Hinrichs from the university, Todd from Tabor, Herrick from Grinnell, with Bessey, Fairchild and Macomber of Ames, Putnam of Davenport and Witter of Muscatine were among the active members in attendance at those meetings. It was at one of these early meetings (1876) that my first effort in the line of a scientific contribution was presented and while it appears to have been a very simple and crude affair it naturally marked an important step in my own interest in scientific work. I have always felt that it was regrettable that this earlier academy had to be abandoned, and it was not until after several sincere efforts to rejuvenate it that the conclusion was finally reached that this was impossible, and the only course left to organize on a new basis.

I shall not attempt here a review of the achievements of our academy. Time and the command of the details both forbid and this feature is to receive attention in another part of our program. I wish, however, to revert briefly to the early hopes of the society and to see in what degree its achievements have measured up to those early aspirations.

In the first annual address before the society, which I may confess here was delivered before a mere handful of scientific friends, I presented some ideas as to what I conceived to be the opportunity for the society and the lines of work desirable in the state. Digging up this buried and long-forgotten address, I have been interested to see in how many respects this forecast has been met and the ideas there advocated provided for in one way or another in the state's activities. Not that I would claim any special foresight or prophetic vision in the case nor that this address had any special weight in securing the results, but that it shows in some degree perhaps the sort of hopes and aspirations for which the members of the Academy stood in those early days.

For example, a geological survey was strongly urged and the organization which soon after followed and the splendid service of this survey to the state have amply justified the plea. A readjustment of the weather service was suggested and the successful combination of the state and government service which was accomplished a few years later and which has proved one of the most effective in the country, is our proof that the hope was not a vain one nor its accomplishment impracticable. The plea for a state museum for the preservation of our native fauna and flora has been met in part at least by the splendid start made in the collections gathered in the historical museum so ably organized by the lamented Charles Aldrich, and many phases of biological investigation have been provided for in the Experiment Station.

The academy volumes which have been published by the state for a number of years have become a distinct feature of the state's activities and are watched for eagerly each year. The record of achievement which they show embraces so many important facts concerning the natural history, geology and other scientific problems that the scientific literature of the state would seem meager without them.

One thing then urged and desired by many of the members seems not yet provided for, at least in fact, and that is a biological survey. This was included in the plan for a geological survey, and though it is specified in the act creating the survey

the actual attention to this phase of the work has been, as all must realize, a very minor matter. No more, I grant, than has been the case in most states where similar conditions exist; no more, perhaps, than seems necessary from the important problems pressing for solution along geological lines. I submit, however, that it is hardly the proper thing to get a survey established with the support of two bodies of workers and then devote all the resources to one line of work, and this condition prevails in far too many states where the so-called geological and natural history surveys are doing little or no biological work, and often that little as a purely gratuitous service from devoted workers.

Speaking now as an outsider and viewing the matter from a distance it appears to me that here is one enterprise that this academy might make one of its pet projects. If a thorough and systematic biological survey can not be pushed forward under the present organization so as to secure accurate knowledge as to the biological resources of the state, then let the biological workers get together to secure provision for the work under some other form of organization.

But I should remember that I have not been invited here to give advice and I am too well aware of the energy with which the Iowa people can advance the projects in which they believe to feel that advice is needed.

On such an occasion as this it seems almost a necessity to attempt some review of the progress made in the lines of work for which we stand, but in addressing myself to this task I am more than ever impressed with the rapidity of this progress and my inability to discuss it. This survey applies more especially to the last quarter century, as this is the period most familiar to me, and of which I can speak most intelligently.

So many principles of fundamental importance in science have been discovered or elucidated during the quarter century that it makes a pretty full record if one makes the attempt to compass it. Among those of especial interest are the determinations concerning the kinetic theory of matter, the progress concerning certain phases of the theory of evolution, the newer aspects of the theories for cosmic evolution, the application of Mendel's law in the problems of heredity, the atomic theory of electricity, and of course numerous others which we can not stop to mention. In some of these there has been such a complete change of view that one who goes back to his school science of a quarter century ago must feel quite lost in the light of new discoveries or imagine himself to have been unconscious for a period and waked up in a new era.

There is perhaps no field or phase of science in which the change of attitude has been more prominent than in the application of science to the problems of every-day life. Science and human welfare, as represented in industry, in public health and sanitation, in the betterment of social conditions, are being linked closer and closer together and the progress in the past quarter century has been more rapid than in any other period of the world's history.

To review the different branches of applied science and to show the details of progress in each would be an impossible task for one person in a brief address and, moreover, much of it is an oft-repeated and familiar tale. We all know something of the marvelous strides in medicine and surgery, one of the most conspicuous fields of science in relation to human welfare, though I doubt if any of us outside the body of active workers in this particular field realize the revolutionary changes that have taken place in surgical methods and therapeutic agencies as a result of the ap-

plication of scientific discoveries in the realm of physiology and biology. Bacteriology alone, which has had practically its entire development within the quarter century, has changed the whole basis of treatment in hosts of diseases and given an entirely new foundation for preventive medicine and sanitation. Still more recently protozoology has entered the field with a present record of many most serious diseases determined as of protozoan basis, and a promise of solution for many more that have baffled medical science for centuries.

In the field of industry the changes of the quarter century have been so enormous as to defy description, at least by one who has not followed the growth in detail. A complete metamorphosis, as a biologist might say, has occurred in many trades and manufacturing industries and practically all based on scientific discoveries and applications. Chemistry, physics, mechanics, biology, geology and other branches of science have contributed their share in this evolution.

In agriculture we see this process at present in one of its most active periods and we can only predict from rapidity of change what the future may bring. Enough, perhaps, to say that production is to be still further accelerated, farm conditions, both for greater production and better living, immeasurably improved and the basis of support for a denser population enlarged. Here, as in medicine, botany, zoology and bacteriology are playing a most important part.

Linked to these phases of human activity in most important manner is the problem of transportation, an activity perhaps more typical of the modern spirit than any other. Locomotion by water, by land and now by air, has been accelerated in a marvelous degree in the quarter century just passed. Twenty years ago I stood in a street in this city of Des Moines and watched a street parade, the most interesting feature of which, to me at least, was a horseless carriage driven by electricity, one of the very few up to that time that had actually been made to work. And for a number of years after that the automobile was in a strictly experimental stage. Now, well it is entirely unnecessary to mention motor boats or motor vehicles or even flying machines as of doubtful accomplishment. I doubt, however, if we fully realize the immense changes produced in our social status by the progress in rapid transit on water or on land for the last few years. As for the place of aerial navigation, that is yet to appear, but I have no doubt as to its practical application in human affairs. It can not displace present modes of travel or transportation, but will, I have no doubt, create a class of service for itself and doubtless one which will have a profound influence on human welfare.

Closely linked again is the question of rapid communication. Foreshadowed by the telegraph, electrical science has in recent years given us the telephone and the wireless as accomplished facts in communication, regardless of time and space. Thirty years ago, when the first commercial lines of telephone were being connected up, it was still looked upon largely as a toy. Very few, even of its most ardent promoters probably, had any conception of how it would alter the conditions of human life, or revolutionize methods of commerce and the relation of social centers, or of city to country. So swiftly and quietly has this come that I doubt if we fully realize the significance of it all. While there still remains to those of us who saw it come some remnant of wonder at the phenomenon, the coming generation

accept it as a matter of course and chatter through the telephone apparently oblivious of the marvelous scientific achievement which put it at their service.

And so we might go on with other achievements of the recent years, the cotton picker, the trolley car, the gas engine, long-distance transmission of power and the moving picture, all of which would have been impossible but for scientific discoveries and their application. I desire, however, to take a little time for the achievements in my own more special field of work—that of entomological science. Not alone because of my greater familiarity with it or because it has been the field of my own labor, but in part because I am constrained to think that the actual progress in this field has not been appreciated, even among biological students, as fully as the facts may warrant.

While to say that economic entomology has been developed in the last quarter century would be putting it too strong, it is true that so large a part of the growth, both for the determination of the fundamental principles and for the application of these to special problems has occurred within this period that it is not unfair to claim it for this epoch.

Less than fifty years ago I was rapping potato vines over a tin pan to catch the potato beetles that were devastating the potato fields in Iowa. In fact, as far as I recall, this was my first entry into the field of economic entomology and I believe about my first financial income was derived from this sort of service. But it was a good many years afterward that methods of control for that pest based on knowledge of habits, life history and chemical poisons were an accomplished fact in economic entomology.

The warfare with the Colorado grasshopper, the cotton worm, the San José scale, the gipsy moth, browntail moth, cotton boll weevil and such old-time pests as the codling moth, chinch bug and Hessian fly have either been fought and more or less completely won within the last quarter century or so nearly within it as to form a part of its history.

One of the very striking lines of progress has been in the transportation of the parasitic enemies of injurious insects, a phase of economic work which had only just begun twenty-five years ago, and which has been practically developed within the last decade with special reference to the depredations of the gipsy moth and the browntail moth. While this mode of contest with injurious insects, especially those which are introduced is not as yet entirely past the experimental stage, so much encouragement has been derived from recent results that we must certainly look upon it as a very important phase of entomological investigation, and one from which we will almost certainly secure important results for certain pests. It may not be possible to duplicate in any case the phenomenal success attained in the control of the cottony-cushion scale in California, but the success with that species and the less perfect success in the case of others must at least point the way to further efforts, and we may expect that a certain number of important species may finally be controlled in this manner.

The methods for control for introduced species the spread of which may be retarded by quarantine or inspection have been developed entirely within the quarter century and the service rendered in this manner is beyond computation.

To a large extent, the content and method of economic entomology have been appropriated in other special fields. Especially is this true in horticulture, where the methods and results of entomological re-

search are appropriated to such a degree that I doubt not many students fail to realize the incorporation. In medicine, also, while we still may speak of medical entomology, the relations to medical research have been so close that we may find difficulty in separating the doctor studying entomology from the entomologist investigating insects with reference to their medical aspects. The fact is that various fields have been opened up to a far greater extent than is possible for one man to follow and we have reached a stage of differentiation when to keep abreast of progress one must confine his effort to a limited part of the entomological field.

But a feature of the subject which I wish especially to emphasize is the attitude of science, or, to be more personal, the scientific worker toward the application of science in human affairs and for human welfare, that is, toward economic or applied science in all its phases.

The time was when probably the greatest efforts in invention and in the application of knowledge were devoted to engines of human destruction, and while this effort may have been a stimulus in the acquisition of knowledge, it could hardly be considered an influence for the promotion of the race.

Now, however, our boast is rather toward the progress in preservation and promotion of life. It is considered cause for glory that we can reduce the percentage of infant mortality, that we can check the spread of pestilence, that we can minimize the dangers of travel, cut down the property loss and the death list from fire or other disaster, and, in short, lengthen the span of human life and improve its opportunities for betterment and enjoyment. And, more significant perhaps, is the fact that such improvement is expected and in large degree made to apply to humanity as a unit, not to any individual or special class.

This attitude is the more conspicuous if we go back a few years to note the trend of scientific ideal. Read, for instance, the plea by Professor Rowland, the brilliant physicist, for devotion to pure science, given in 1885.

I remember how in my own experience scarce thirty years ago the venerable Dr. Hagen, doubtless the most profound student of entomology of the time if not of the century, made a most emphatic plea with me, with all the force of his German accent, not to go into economic entomology, but to give my effort to the pure science, "for the love of the science."

Now I believe that this attitude differed more in appearance than in fact, that the devotees of science, while some of them really did not care to have their discoveries made of any value to mankind, were really protesting against the commercializing of their scientific talent rather than the utilization of science for the good of humanity and often a plea simply for continuous drafts on original sources of knowledge instead of mere applications of knowledge gained. Certainly it is inconsistent with any reasonable desire for the acquisition of knowledge to deplore its use. Nor does it look strictly consistent for a person with this claim to sell his talent even to a university or a research institute for so much even as the moderate salaries that they usually afford.

But the attitude which I believe is becoming most dominant with scientists is that of the service of science to humanity at large, and the wish that beyond reasonable return for the work involved the profit should not be allowed to pile up for the benefit of a few.

What satisfaction is there in discovering a method by which to gain a double

crop from the soil, to avoid loss from destructive agencies, or to double the capacity of human labor if the gain is all absorbed by an aggressive few and the scientist and the real producer are left with no betterment of condition.

Such absorption does too often occur and it is not much to be wondered at that the pessimistically inclined should question what profit there is in our boasted scientific progress if the advantages of it all are to be seized upon and appropriated by an inner circle who can. One of the most important problems of the age is to discover how the gains of scientific discovery may be equitably shared by all deserving members of society.

But such an occasion impels us to look forward as well as backward. What will the next quarter century of science reveal to us of the unknown, what problems of age-long study will have yielded their solution, what theories of to-day will have vanished and what will be the nature of those to take their place. For this we can simply say wait and see; we may be content to believe that progress must continue and I believe we may also say that in most lines this progress will be on the foundations already laid. For one, I have sufficient faith in the science of to-day to believe that we have reached a secure footing and that we may push forward with confidence that the structure we build will not be doomed to complete destruction, even if in some of its details the lines must be recast. At least one strong ground for effort is confidence in the truth and permanence of the structure on which we work and despite occasional voicings of dissent I would hold for faith in our own work.

When the next quarter century shall have passed and you celebrate another anniversary, as I have no doubt you will, for the academy is now so fully established that its lapse is unthinkable, you will plan a wider home-coming to include the many members who will have scattered farther still to the ends of the earth and I shall hope to meet many or all of you now here with many yet to come in that semicentenary of our birth. Mr. President, you need not for that occasion send me any invitation. I shall come without one if alive, as I hope to be, and if it is within the range of human possibility to do so. But whether here in flesh or not, I assure you I shall be in thought and spirit, for I shall carry with me from this day on not only my early love and devotion for the academy, but an abiding appreciation for the honor you have shown me in asking me to be present with you and for the cordial greetings from you all. For all this and for your kind indulgence in listening to these remarks, I most sincerely thank you.

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ECONOMY IN UNIVERSITY ADMINISTRATION

I PROPOSE to consider briefly what I believe to be the most important factor in university economy, namely, the selection of the work which the university shall undertake.

Every important development depends upon two conditions: first, an adequate stock of energy; second, the selection of a few out of many possible channels through which that energy may produce its best results. A man will grow apples. His first concern is to secure a maximum amount of apple-producing energy in the form of well-bred stock, good soil, appropriate fertilizers, *et cetera*. His second concern is to save that energy from being wasted through weeds, through too many trees per acre, too many limbs upon the trees, or too many apples upon the limbs. His chief